REMARKS

In view of the above amendments and the following remarks, reconsideration of the rejections contained in the Office Action of September 20, 2002 is respectfully requested.

The specification has been revised in order to provide antecedent basis and a clear intended meaning of several new terms used in the claims. Specifically, the terms "outer-side face," "inside," and "outside" which are recited in new claims 56-79 have been defined in the specification with reference to the drawings. For the Examiner's benefit, a copy of the marked-up page of the substitute specification (which was submitted on June 20, 2002) has also been submitted. These specification amendments are fully supported by the original disclosure and, therefore, it is submitted that no new matter has been added by these amendments. Thus, the Examiner is respectfully requested to approve and enter the amendments.

The Examiner has rejected claims 10 and 24 under 35 USC § 112, first paragraph, as containing subject matter that was not sufficiently described in the specification. In addition, the Examiner has rejected claims 2-5, 10-12 and 55 under 35 USC § 112, second paragraph, as being indefinite. However, as indicated above, the original claims have been cancelled and replaced with new claims 56-79. The new claims have been carefully drafted so as to fully comply with all of the requirements of 35 USC § 112 and, therefore, it is submitted that the Examiner's formal rejections under § 112 are not applicable to the new claims.

The Examiner has rejected claims 2-10, 15-24 and 55 as being unpatentable over the Higuchi reference (USP 5,783,492) in view of the Chen reference (USP 5,824,605); has rejected claims 2-4, 11-12, 15-17, and 25-26 as being unpatentable over the Bhardwaj reference (USP 6,259,209) in view

of the Higuchi reference; has rejected claims 2-5, 10, 15-17, 24, and 55 as being anticipated by, or obvious in view of, the Tomoyasu reference (USP 5,904,780); and has rejected claims 2-5, 10, 15-17, 24, and 55 as being unpatentable over the Tomoyasu reference in view of the Higuchi reference. However, as indicated above, the original claims have been cancelled and replaced with new claims 56-79. For the reasons discussed below, it is respectfully submitted that these new claims are clearly patentable over the prior art of record.

New independent claims 56 and 68 are directed to a method of generating plasma within a vacuum chamber and a plasma processing apparatus, respectively, in which a substrate is processed within a vacuum chamber having an electrode positioned opposite the substrate. A *single annular groove is arranged at the electrode so that an outer-side face of the annular groove is located inside of an inner surface of a side wall of the vacuum chamber*. In this regard, the specification has been amended as discussed above to clarify the meaning of the terms "outer-side face" and "inside." As a result of this arrangement of the annular ring, plasma distribution on the substrate can be accurately controlled so as to greatly improve the substrate processing efficiency and quality.

The Higuchi reference discloses a plasma processing method and device in which a substrate is processed within a vacuum chamber. The Examiner asserts that Figures 9 and 10 of the Higuchi reference show a gap or groove between the wall of the vacuum chamber and the side wall 211 of a dielectric window. However, the outer-side face of the "groove" of the Higuchi reference *is* the side wall of the vacuum chamber. Thus, the Higuchi reference does not disclose or suggest an annular groove arranged at the electrode so that so that an outer-side face of the annular groove is

located *inside* of an inner surface of a side wall of the vacuum chamber (as the terms "outer-side face" and "inside" are defined in this application).

The Chen reference also discloses a plasma processing method and device in which a substrate is processed within a vacuum chamber. The Examiner asserts that the Chen reference discloses a dielectric window 18a, 18b having a groove formed therein, and that the dielectric window 18a, 18b does not extend all the way to the side wall of the vacuum chamber. However, as clearly shown in Figure 4, the groove of the Chen reference is formed in the dielectric window. Thus, the Chen reference does not disclose a groove arranged at the (opposite) electrode.

The Tomoyasu reference and the Bhardwaj reference both disclose plasma processing methods and devices, in which multiple grooves are formed within the vacuum chamber. Specifically, Figure 2 of the Bhardwaj reference appears to disclose at least two annular rings 20, 21 formed between the support structures 22, 23. However, the Tomoyasu reference and the Bhardwaj reference do not disclose or suggest a *single* annular groove arranged at the electrode.

As explained above, the Higuchi reference, the Chen reference, the Bhardwaj reference and the Tomoyasu reference do not, either alone or in combination, disclose or suggest a method and apparatus for generating plasma within a vacuum chamber, including a singular annular groove arranged as recited in claims 56 and 68. Therefore, one of ordinary skill in the art would not be motivated to modify or combine the references so as to obtain the invention recited in claims 56 and 68. Accordingly, it is respectfully submitted that claims 56 and 68, and the claims that depend therefrom, are clearly patentable over the prior art of record.

New independent claims 59 and 71 are directed to a method of generating plasma and a plasma processing apparatus, respectively, in which a substrate is processed within a vacuum chamber having an electrode positioned opposite the substrate. *An annular groove is arranged outside of the electrode so that an outer-side face of the annular groove is located inside of the inner surface of a side wall of the vacuum chamber, and so that a surface area inside of the annular groove including the electrode is 0.5 - 2.5 times as large as the surface area of the substrate.* In this regard, the specification has been amended as discussed above to clarify the meaning of the terms "outer-side face," "inside," and "outside." As a result of this arrangement of the annular ring, plasma distribution on the substrate can be accurately controlled so as to greatly improve the substrate processing efficiency and quality.

As explained above with respect to claims 56 and 68, the Higuchi reference discloses an arrangement in which the outer-side face of the annular groove comprises the side wall of the vacuum chamber. Thus, the Higuchi reference does not disclose that the outer-side face of the annular groove is located *inside* of an inner surface of the side wall of the vacuum chamber. In addition, the Chen reference does not disclose an annular ring arranged outside the electrode, since the electrode is located above the annular ring in dielectric window 18a, 18b as shown in Figure 4, and the Bhardwaj reference and the Tomoyasu also do not disclose or suggest this arrangement.

Furthermore, the Higuchi reference, the Chen reference, Bhardwaj reference, and the Tomoyasu reference also do not disclose or suggest that a surface area inside of the annular groove including the electrode is 0.5 to 2.5 times as large as the surface area of the substrate. Thus, these references do not, either alone or in combination, disclose or suggest a method and apparatus for

generating plasma including an annular groove arranged as recited in new independent claims 59 and 71. Therefore, one of ordinary skill in the art would not be motivated to modify or combine the references so as to obtain the invention recited in new independent claims 59 and 71. Accordingly, it is respectfully submitted that independent claims 59 and 71, and the claims that depend therefrom, are clearly patentable over the prior art of record.

New independent claims 64 and 76 are directed to a method of generating plasma and a plasma processing apparatus, respectively, in which a substrate is processed within a vacuum chamber. Plasma is generated by radiating electromagnetic waves into an interior of the vacuum chamber via a dielectric window positioned opposite the substrate. *A single annular groove is arranged at the dielectric window so that an outer-side face of the annular groove is located inside of an inner surface of a side wall of the vacuum chamber, and so that an annular groove has a groove width in a range of 3mm to 50mm.* In this regard, the specification has been amended as discussed above to clarify the meaning of the terms "outer-side face," "inside," and "outside." As a result of this arrangement of the annular ring, plasma distribution on the substrate can be accurately controlled so as to greatly improve the substrate processing efficiency and quality.

As explained above, the Higuchi reference does not disclose or suggest an annular groove arranged so that an outer-side face of the annular groove is located *inside* of an inner surface of a side wall. As also explained above, both the Bhardwaj reference and the Tomoyasu reference disclose multiple annular rings in the vacuum chamber and, therefore, do not disclose or suggest a *single annular groove* arranged at a dielectric window.

In addition, the Higuchi reference, the Chen reference, the Bhardwaj reference, and the Tomoyasu reference do not disclose or suggest that the annular groove has a groove width in a range of 3mm to 50mm. Thus, these references do not, either alone or in combination, disclose or suggest a method and apparatus for generating plasma including a single annular groove arranged as recited in new independent claims 64 and 76. Therefore, one of ordinary skill in the art would not be motivated to modify or combine the references so as to obtain the invention recited in new independent claim 64 and 76. Accordingly, it is respectfully submitted that new independent claims 64 and 76, and the claims that depend therefrom, are clearly patentable over the prior art of record.

New independent claims 66 and 78 are directed to a method of generating plasma and a plasma processing apparatus, respectively, in which a substrate is processed within a vacuum chamber. Plasma is generated in the vacuum chamber by radiating electromagnetic waves into an interior of the vacuum chamber via a dielectric window positioned opposite the substrate. *An annular groove is arranged outside of the dielectric window so that an outer-side face of the annular groove is located inside of an inner surface of a side wall of the vacuum chamber, and so that a surface area inside of the annular groove including the dielectric window is 0.5 to 2.5 times as large as a surface area of the substrate. The annular groove also has a groove width in a range of 3mm to 50 mm.* In this regard, the specification has been amended as discussed above to clarify the meaning of the terms "outer-side face," "inside," and "outside." As a result of this arrangement of the annular ring, plasma distribution on the substrate can be accurately controlled so as to greatly improve the substrate processing efficiency and quality.

As explained above, the Higuchi reference does not disclose or suggest an annular groove having an outer-side face located inside of an inner surface of a side wall of the vacuum chamber, and the Chen reference does not disclose or suggest an annular groove arranged outside of a dielectric window.

In addition, the Higuchi reference, the Chen reference, the Bhardwaj reference, and the Tomoyasu reference do not disclose or suggest that a surface area inside of the annular groove is 0.5 to 2.5 times as large as a surface area of the substrate, and do not disclose or suggest that the annular groove has a groove width in a range of 3 mm to 50 mm. Thus, these references do not, either alone or in combination, disclose or suggest a method and apparatus for generating plasma including an annular groove arranged as recited in new independent claims 66 and 78. Therefore, one of ordinary skill in the art would not be motivated to modify or combine the references so as to obtain the invention recited in claims 66 and 78. Accordingly, it is respectfully submitted that new independent claims 66 and 78 and the claims that depend therefrom are clearly patentable over the prior art of record.

In view of the above amendments and remarks, it is submitted that the present application is now in condition for allowance. However, if the Examiner should have any comments or suggestions to help speed the prosecution of this application, the Examiner is requested to contact the Applicant's undersigned representative.

Respectfully submitted,

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Version with Markings to
Show Changes Made

Detailed Description of the Preferred Embodiments

[0111] Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals throughout the accompanying drawings.

[0112] Hereinbelow, embodiments according to the present invention are described in detail with reference to the accompanying drawings.

[0113] A first embodiment of the present invention is described below with reference to Figs. 1A, 1B, and 2.

[0114] Fig. 1A shows a sectional view of a plasma processing apparatus employed in the first embodiment of the present invention. Referring to Fig. 1A, while the interior of a vacuum chamber 1 is maintained at a specified pressure by introducing a specified gas from a gas supply unit 2 into the vacuum chamber 1 and by simultaneously performing evacuation by a pump 3 as an evacuating device, a high-frequency power of 100 MHz is supplied to a counter electrode 5 by a counter-electrode-use-high-frequency power supply 4. Then, plasma is generated in the vacuum chamber 1, where plasma processing such as etching, deposition, and surface reforming can be carried out on a substrate 7 placed on a substrate electrode 6. A substrate-electrode-use-high-frequency power supply 8 for supplying high-frequency power to the substrate electrode 6 is also provided, so that ion energy that reaches the substrate 7 can be controlled. Also, an annular, groove-like plasma trap 9 shown in Figs. 1A and 1B is provided opposite to the substrate 7, making it possible to process the substrate 7 while the plasma distribution on the substrate 7 is controlled. The plasma trap 9 is provided in the counter electrode 5. Out of surfaces forming inner wall surfaces of the vacuum chamber 1 and opposing the substrate 7, an electrode portion 10 (cross hatched portion) surrounded by the plasma trap 9 has an area 0.8 time that of the substrate 7, as one example. Also, the groove width of the plasma trap 9 is 10 mm, and the groove depth of the plasma trap 9 is 15 mm, as one example. In addition, the counter electrode 5 is insulated from the vacuum chamber 1 by an insulating ring 11. AS SHOWN IN FIGURE 1A (AS WELL AS THE OTHER FIGURE) THE ANNULAR GROOVE (PLASMA TRAP) 9 HAS A BOTTOM FACE, AN OUTER-SIDE FACE CLOSEST TO THE SIDE WALL OF THE VACUUM CHAMBER 1, AND AN INNER-SIDE FACE FARTHEST FROM THE SIDE WALL OF THE VACUUM CHAMBER 1. AS CAN BE SEEN, THE OUTER-SIDE FACE OF THE ANNULAR GROOVE 9 IS LOCATED "INSIDE" OF THE INNER SURFACE OF THE SIDE WALL OF THE VACUUM CHAMBER. IN THIS REGARD, THE TERMS "INSIDE" AND "OUTSIDE" MEAN CLOSER TO AND FARTHER FROM, RESPECTIVELY, A VERTICAL CENTER AXIS OF THE VACUUM CHAMBER.